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Research Article

Water vapor formation causing reversible aerodynamic effect on the distribution of aero-algal forms

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Abstract: Aerodynamic is a branch which deals with the study of takeoff and passive transport mechanism of bio-particles with the help of physical and mathematical modules. But there is not a single report on the aero-dynamic study with respect to manipulated meteorological condition. Nagpur being hottest during summer month, the frequency of using air coolers is very high. An air cooler is a device which evaporates water with the help of fan to bring down room temperatures which results into increase in room humidity very much. To study the effect of humidity on the distribution and occurrence of aero algal forms sampling was carried out at three different sites, fitted with air cooler, from April- Mid May, using Rotarod sampler. Total 84 algal forms were recorded from 46 samples collected from three different sites. Cyanophyta was found to be dominant, followed by Bacillariophyta, Chlorophyta and Euglenophyta respectively. *Trentipholia* is found to be dominant algal forms followed by *Chroococcos, Microcystis, Aphanocapsa, Chlorella* & *Euglena* respectively. Forms such as *Chroococcidiopsis, Merismopedia, Aphanocapsa, Gleocapsa, Phormidium, Hormidium* & *Pinnularia* were recorded in equal proportion. Forms such as *Chlorella, Microcystis, Phormidium* & *Hormidium* reported to be allergenic has been encountered. Irrespective of dry environmental condition with high temperature and low humidity (the condition considered to be favourable for dispersal of aero-algal forms, resulting into high concentration of air-borne algal flora) during sampling period, at all the three sites, minimum number of aero-algal forms were encountered due to increased humidity at the sampling sites. This can be due to manipulated micrometeorological conditions resulting into reversible aerodynamic effect on the aero- algal forms. Humidity of room air is increased by releasing water droplets in the atmosphere which act as a mode of reversible dispersion of aero-algal forms from higher level to the ground level, resulting into reduction in aero-algal counts at human breathing level. This finding, if experimented further with aero-algal and other bio-particles, can be good news for allergy patients.

Keywords: Manipulated micrometeorological conditions; Humidity; Aero-algal counts; Air- cooler; Aerodynamic; Allergy.

Introduction

Today's biggest concern all over the world is global warming due to presence of high level of aero-pollutants in the atmosphere. Bio-pollutants are one of its major constituent with algal forms as one of its important component. Number of Aerophycologist have contributed in this field regarding occurrence, distribution, variation in aeroalgal forms from various different places. But very few reports were their regarding aerodynamic of aeroalgal forms.

Aerodynamic is a branch which deals with the study of take - off and passive transport mechanism of bio-particles with the help of physical and mathematical modules. Patel *et al.,* (2005), Karnik (1962), Shenoi *et al.,* (1976) reported that some aquatic and terrestrial algae may become air-borne due to rain. Schlichting (1971, 1974), Woodcook (1948) suggested that bursting bubbles from breaking waves results into formation of aerosols (sea water nuclei) in oceanic air. Mc Craw (1967) during his studies of Taylor, Dry valley, Victoria land and Antarctica concluded that algae are frequently picked up from soil by strong wind currents. Broady (1979, 1984, 1996), Broady *et al.,* (1991) recorded wind dispersal of terrestrial algae at Signy and Ross islands in Antarctica. Schlichting *et al.,* (1978) suggested dispersal of algae by Antarctica flying birds. Wuthric *et al.,* (1981) reported transport of diatoms by wind, waterbirds and aquatic insects in Europe. Similarly, correlation between meterological conditions with seasonal variation in aeroalgal counts has also been reported. Schlichting (1964), Brown *et al.,* (1963), Ehresmann & Hatch (1975), Carson & Brown (1976), Roses *et al.,* (1987,1989), Nair *et al.,* (1983) and A.C. Devi & N.I. Singh (2005), Sudershankumar *et al.,* (1984) have discussed the relevance of air-borne algae with micrometerological and geographic parameters. Wharton *et al.,* (1981, 1983) proposed an algal recycling table between fresh water, supra-glacial and terrestrial populations via an aerobiota which depends on the wind strength and direction. R. Troma *et al.,* (2001) suggested wind speed and direction having positive effect in dispersal of aero-algal forms. But there is not a single report on the aero-dynamic study with respect to manipulated meteorological condition. Hence the present work was considered for further studies.

Material and Methods

Nagpur being hottest during summer month, the frequency of using air coolers is very high. An air cooler is a device which evaporates water with the help of fan to bring down room temperatures which results into increase in room humidity very much. To study the effect of humidity on the distribution and occurrence of aero algal forms sampling was carried out at three different sites. All the sampling was carried out using Rotarod samples, (Perkins, 1957)

Site- I

Rotarod sampling from the bathroom of residential house at Pratap Nagar

Two samples (2nd May & 22nd May) were collected from bathroom of residential house of Mr. Suresh Vinayak Khadke at Pratap Nagar. Sampler was placed on a 30" high stool, inside the bathroom. Sampling period is of 30 minutes/sample.

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Site- II

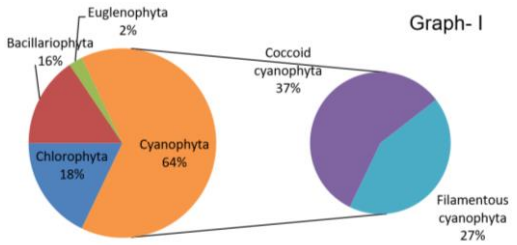
Rotarod sample of bed room fitted with an air-cooler, at Pratap Nagar, Nagpur

Forty-three samples were collected from the bed room of Mr Suresh Vinayak Khadke. An air cooler has been fixed in one of the windows of this bed room and samples were collected during summer (from 1stApril- 13thMay) when this air cooler was being used every day. Sampling period is of 15 minutes/sample.

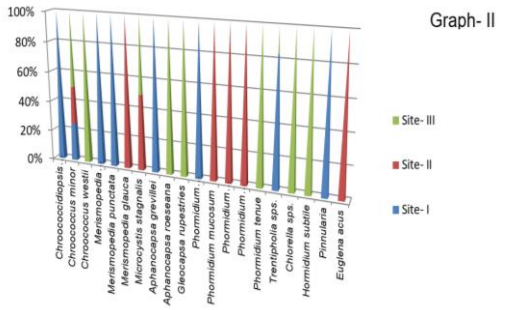
Site- III

Rotarod sampling from the air- cooler factory premises of 'Poly coolers', situated at Ravi Nagar, Nagpur

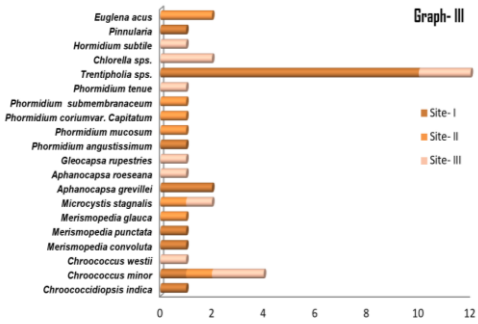
Single sample was collected on (16thApril) from the premises of 'poly'coolers, Air cooler factory, situated at Ravi Nagar. Sampling period is of 30 minutes. During sampling at Site- I and Site- III, two strips of cellophane tape coated with petroleum jelly were mounted across the two bars of the rotarod sampler. After sampling one of the strip was mounted on a slide with glycerine jelly for direct microscopic examination and another strip was dropped in sterilized (6"x 1") test tube containing BG- 11 culture medium. Entire mounting and culturing procedures were carried out at the sampling site, to avoid contamination during transit. Cultures were allowed to grow under natural condition. Algal forms from cultures were isolated and mounted in glycerine, for further examination. At Site- II, only one strip of cellophane tape coated with petroleum jelly was mounted across the two bars of the rotarod sampler. After sampling the strip was mounted on a slide with glycerine jelly for direct microscopic examination. Identification of algal forms was done on the basis of morphological characters by comparing them with available literature. Fritsch (1935, 1945) and Desikachary (1959).



Class Frequency based on aeroalgal flora encountered from the samples



Comparative Account of Aeroalgal forms reported from sampling sites



Frequency occurence of different aeroalgal forms during sampling period

Results and Discussion

Total 18 algal forms were recorded from two samples (2 Slides & 2 Culture slides) obtained from Site- I sampling. All 18 forms were identified upto generic level & 7 forms were identified upto species level. Chlorophyta was found to be dominant group represented by 10 algal forms followed by Cyanophyta 7 (6 Coccoid and 1 Filamentous) forms. Bacillariophyta was represented by a single form only. Two species of *Merismopedia* and one each species of *Chroococcidiopsis, Chroococcus* & *Phormidium* were recorded (Observation Table- I).

Table I. Comparative account of aero-algal forms recorded at different sites

Sr.No.	Particulars	Site- I	Site- II	Site-III	Total
1	Number of samples	4	43	1	46
2	Duration of sampling (Min.)	60	654	30	735
3	Total algal forms	18	54	12	84
4	Cyanophyta	7	40	7	54
5	Coccoidcyanophyta	6	19	6	31
6	Filamentous cyanophyta	1	21	1	23
7	Chlorophyta	10	Nil	5	15
8	Bacillariophyta	1	12	Nil	13
9	Euglenophyta	Nil	2	Nil	2
10	*Chroococcidiopsis indica*	1	Nil	Nil	1
11	*Chroococcus minor*	1	1	2	4
12	*Chroococcus westii*	Nil	Nil	1	1
13	*Merismopedia convoluta*	1	Nil	Nil	1
14	*Merismopedia punctata*	1	Nil	Nil	1
15	*Merismopedia glauca*	Nil	1	Nil	1
16	*Microcystis stagnalis*	Nil	1	1	2
17	*Aphanocapsa grevillei*	2	Nil	Nil	2
18	*Aphanocapsa roeseana*	Nil	Nil	1	1
19	*Gleocapsa rupestries*	Nil	Nil	1	1
20	*Phormidium angustissimum*	1	Nil	Nil	1
21	*Phormidium mucosum*	Nil	1	Nil	1
22	*Phormidium coriumvar. Capitatum*	Nil	1	Nil	1
23	*Phormidium submembranaceum*	Nil	1	Nil	1
24	*Phormidium tenue*	Nil	Nil	1	1

25	*Trentipholia* sps.	10	Nil	2	12
26	*Chlorella* sps.	Nil	Nil	2	2
27	*Hormidium subtile*	Nil	Nil	1	1
28	*Pinnularia* sps	1	Nil	Nil	1
29	*Euglena acus*	Nil	2	Nil	2
SITE- I	**Sampling from the bathroom of residential house**				
SITE- II	**Sampling from bed room, fitted with an air- cooler**				
SITE- III	**Sampling from the air- cooler factory premises of 'Poly coolers'**				

Out of 43 slides prepared from Site- II samples, 15 slides were recorded negative. Out of 28 positive slides, 54 algal forms were recorded. All 54 forms were identified upto class level, out of which 8 forms were identified upto generic as well as species level. Cyanophyta, the most frequent one, was represented by 40 (19 Coccoid and 21 filamentous) forms. Bacillariophyta was represented by 12 forms and 2 forms of Euglenophyta were recorded. Three species of *Phormidium* and one each species of *Chroococcus, Merismopedia, Microcystis* and *Euglena* were recorded (Observation Table- I). From the single sample collected from Site- III, 12 algal forms were recorded. All 12 forms were identified upto generic level out of which 8 forms were identified upto species level. Cyanophyta was represented by 7(6 Coccoid& 1 Filamentous) forms followed by 5 Chlorophyta forms respectively. Two species of *Chroococcus* and one species each of *Gleocapsa, Phormidium, Aphanocapsa, Microcystis* and *Hormidium* could be identified (Observation Table- I). *Chroococcidiopsis indica, Merismopedia convolute, Merismopedia punctate, Aphanocapsa grevillei, Phormidium angustissimum* & *Pinnularia* were recorded from Site- I only. Similarly, *Merismopedia glauca, Phormidium mucosum, Phormidium corium var. capitatum, Phormidium submembranaceum* & *Euglena acus* were observed from site – II only (irrespective of the same sampling place with different spot). Forms such as *Chroococcus westii, Aphanocapsa roeseana, Gleocapsa rupestries, Phormidium tenue, Hormidium subtitle* & *Chlorella* sps were reported from site – III only. *Microcystis stagnalis* is reported from both site- II & Site- III, were as *Trentipholia* sps is reported from both site- I & site- III respectively. *Chroococcus minor* is the only aero-algal form recorded from all the three sites (Graph- II).

Since sampling was conducted in month of April- May, the meteorological conditions were going to be constant for all the three sampling sites. But the results obtained at three different sites shows a huge diversity among the algal forms recorded (Graph- II). This clearly indicates that instead of only correlating metrological parameters during sampling period, emphasis should also be given for micro- metrological conditions prevailing at the sampling site during sampling.

Trentipholia is found to be dominant algal forms followed by *Chroococos, Microcystis, Aphanocapsa, Chlorella* & *Euglena* respectively. Forms such as *Chroococcidiopsis, Merismopedia, Aphanocapsa, Gleocapsa, Phormidium, Hormidium* & *Pinnularia* were recorded in equal proportion (Graph- III).

Total 84 algal forms were recorded from 46 samples collected from three different sites. Cyanophyta was found to be dominant, followed by Bacillaciophyta, Chlorophyta and Euglenophyta respectively (Graph- I). N. K. Sharma *et al.,* (2006) reported Cyanophyta as dominant group from Varanasi. All 84 forms were identified upto class level, 38 forms were identified upto generic level and 23 forms were identified upto species level. Cyanophycean forms recorded were *Phormidium, Chrococcus, Aphanocapsa, Merismopedia, Microcystis, Gleocapsa* & *Chroococcidiopus*. Chlorophyceans forms recorded were *Trentipholia, Chlorella* & *Hormidium*. Bacillariophyta was represented by *Pinnularia* were as Euglenophyta was represented by *Euglena* (Observation table- I). Forms such as *Chlorella, Microcystis, Phormidium* & *Hormidium* reported to be allergenic (Anostasia Chrisostomou *et al.,* (2009), Bernstein and Safferman (1966, 1970), Paul Garham and Wayne Carmichael (1979), Mittal *et al.,* (1973,1979), Goyal S. K (1976) & Tilak (1992), has been encountered.

Conclusion

Sampling was carried out during dry summer month of April- May, with high temperature and relatively low humidity, was considered to be favourable condition for dispersal of various aero-algal forms as reported by J. T. Pandkar (2008), Pandkar J. T. (2012), N.K. Sharma *et al.,* (2006), R. Tromo *et al.,* (2001) from Bedajoz (SW Spain) city reported maximum aero-algal concentration during May- June and shows positive correlation with temperature and negative correlation with humidity. But at all the three sites, minimum number of aero-algal forms were encountered, may be due to manipulated micrometeorological conditions resulting into reversible aerodynamic effect on the aero- algal forms (S.C. Santra (1987) reported limited Number of air-borne algae from June- Mid September due to high humidity and rain washing). Effect of Air-Cooler (which has become a common house hold item now a days) on aero-algal concentration was also studied for the first time. It was observed that an air- cooler, by increasing humidity of room air, reduces aero-algal counts. Humidity of room air is increased by releasing water droplets in the atmosphere which act as a mode of reversible dispersion of aero-algal forms from higher level to the ground level, resulting into reduction in aero-algal counts at human breathing level. This finding, if experimented further with aero-algal and other bio-particles, can be good news for allergy patients.

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